On The Socio-Economic Implications of Teleprocessing

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Dr. Barry Lesser
Centre for Development Projects
Dalhousie University

A report prepared for the Department of Communications, Government of Canada.

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Preface

The growing merger of computer and communications technology is revolutionizing the world. If this seems an overstatement, it is only because we have hardly begun to understand, and to document, the profound economic, social, cultural and political implications which will accompany, and be produced by, this marriage of technologies. As has been noted by Andrieu and Serafini,

> The social and economic impact of the information revolution could be as profound as that of the industrial revolution....It touches upon virtually every aspect of our economic, social, cultural and political life as a people.(1)

This so-called "information revolution" has, to date, received the greatest attention in the industrialized, developed nations of the world. These nations have the most advanced telecommunications networks and the most advanced computers. The technology, in general, has been developed or invented in these countries. Globally the major producers and users of computers, telecommunications and combined computer/communications technologies are in these countries. The applications of the new technolgies are most obvious and the advantages most apparent in these countries.

The presumption that computer/communications technology is primarily of relevance in developed countries, however, has begun to be questioned. First, the technology, by its

very nature, has fostered increased global interdependence. As Eger notes,

> ....developments in the computer and telecommunications industries have permitted increased communications over longer distances, at greater speeds, at ever-diminishing costs, virtually shrinking the globe.(2)

Developing countries cannot afford to ignore the implications of the technology even if they do choose not to make use of it themselves.

Second, there is a growing awareness of the positive benefits of telecommunications as an instrument for economic and social development in developing countries. Traditionally, telecommunications has received little attention amongst development economists and planning personnel. There has been a tendency to regard telecommunications as the telephone and to regard the telephone as a "luxury good" for the urban elite.(3) But these assumptions are being questioned as it is recognized that a) telecommunications is more than basic telephone service, i.e., voice messages, and b) that basic telephone service is, itself, of major potential significance for both economic and social development.(4) Although telecommunications investment in developing countries is still subject to major financial, technical, and economic constraints, more and more developing countries are trying to improve the quantity and quality of telecommunications services. In the process more "advanced" applications of telecommunications such as data transmissions are also being examined.

Third, developing countries seeking to upgrade their telecommunications infrastructure today have the advantage of being able to build their system with technology that can do much more than provide voice-message service. The developed countries saw their telecommunications systems go through several successive stages of technology. It took them a relatively long time to get to where they are now. Along the way, obsolete technology, which was kept in the network, often impeded the rate of growth of computer/communications-type services. Developing countries have lost benefits over time because their telecommunications networks have remained underdeveloped or undeveloped. But they can now build their systems with the newest technology and, in hardware terms at least, immediately make possible what the developed countries took many years to achieve. As Arthur Clarke has noted,

> The appropriate technology for the developing world is electronic digital technology. It brings forms of communication that are cheap and ideally suited for people who cannot read. It gives the third world a chance to leapfrog into the space age, without investing in the expensive copper-wire networks that slow down the industrialized world's telecommunications advance.(5)

The computer-communications revolution, then, is of relevance to developing countries; offers potentially significant benefits in terms of social and economic development; and, as telecommunications infrastructure receives increasingly more emphasis in countries' development plans and incorporates the most modern technology, the capability for computer/communications in developing countries will become an increasingly real possibility.

To sum up, in the words of the MacBride Commission:

> Given the obvious importance of the telephone, many countries appear to have erred in neglecting to build adequate telephone networks. Unlike the rising costs of some postal services, the decreasing costs for some newer technologies, such as the telephone and electronic data transmittal, will undoubtedly force changes in telecommunications strategies. International and national development assistance institutions will have to consider upgrading the low priority which has hitherto been given to telecommunications projects. Hence, policy decisions on the development and financing of communication services are today a priority for all governments, professional communicators, and the public at large.(6)

At the same time as computer/communications technology and its applications hold out tremendous promise to developing countries, there are also significant problems posed by the technology for these countries. Fears of "electronic imperialism" or "electronic colonialism" are heard frequently in international forums and elsewhere. There is concern that the industrialized nations will control the global information order for their own ends as, it is charged, they previously exploited the material resource base of the developing countries. This is a very emotion-laden argument but, within it, there most certainly do lie causes for real concern.(7)

If developing countries are to maximize the benefits realizable from computer/communications technology while minimizing the costs, a great deal more must be known about the potential benefits and costs of telecommunications and, more specifically, the potential benefits and costs of combined computer/communications applications in these countries.

Much can be learned in such an investigation from the experience to date of developed countries as well as the relatively limited experience to date in developing countries themselves.

This report represents part of an ITU investigation of these questions. It is concerned with the socio-economic implications of teleprocessing in developing countries. Teleprocessing in the context of this report will be taken to mean the combined application of computer and communications services.

The report is divided into three separate parts:

1. a literature review/survey of the development, and development benefits, of telecommunications and teleprocessing in developing countries
2. a case study on the development of teleprocessing in Canada, with emphasis on the implications of Canadian experience for developing countries, and
3. an outline of a case study methodology for subsequent detailed study of the teleprocessing experience of developing countries, together with a list of suitable countries in which these case studies might be carried out.

This report is not intended to provide any definitive answers to the questions surrounding the application of teleprocessing in developing countries. It will, hopefully, point out the issues and provide a methodological basis for proceeding with more in-depth study.

Footnotes:

1. M. Andrieu and S. Serafini, The Information Revolution and Its Implications for Canada, (Ottawa: Supply and and Services, Government of Canada, 1981), p. 8.

2. J. Eger, "The International Information War", Computerworld Extra, XV, 11a, March 18, 1981, p. 103.

3. See, for example, John Clippinger, "Can Communications Development Benefit the Third World?" Program on Information Resources Policy, Harvard University, December 16, 1976 (mimeo), for a discussion of this argument.

4. This role of telecommunications is discussed in detail in the next section.

5. Arthur Clarke, quoted in "Telecommunications: a survey-- The born-again technology", The Economist, August 22, 1981, p. s22.

6. S. MacBride, et. al., Many Voices, One World, Report by the International Commission for the Study of Communication Problems, (Paris: UNESCO, 1981), p. 72.

7. See J. Eger, op. cit., pp. 116-117.

Part I

The Status of Telecommunications and Teleprocessing in Developing Countries: A Survey Based on the Literature

As of January 1, 1979, close to 75% of the world's telephones were in North America, Europe, and the U.S.S.R.[1] As of January 1978, there was less than 1 telephone per 100 population amongst Subsaharan African countries, on average.[2] For the same period, the United States and Switzerland had more than 70 telephones per 100 population, Canada and Sweden had more than 60, and developed countries, as a whole, had an average well over 30 telephones per 100 population.[3] Obviously there is an extreme gap in the availability of telephone service between developed and developing nations.

There are equally major gaps in the level of telephone availability and the level of telephone penetration amongst developing countries. In Africa, for example, Zimbabwe has 208,000 telephones with 3 telephones per 100 population while Mali has 5700 telephones with .09 telephones per 100 population.[4] Zimbabwe's penetration or telephone density is thus 33 times that of Mali. In Latin America there are less than 5 phones per 100 population at the same time as 63% of all phones are in just three countries, Brazil, Argentina, and Mexico.[5]

These figures are illustrative not only of wide disparities in the availability and accesibility of basic telephone service,

but, by extension, of all telecommunications services. The gaps between developed and developing countries are, in fact, greater for other terminal equipment (e.g., computer terminals) than for telephone sets.

At the same time, within most developing countries there is a pronounced gap in telephone penetration ratios between urban and rural areas.(6) A strong case can be made for improved service in rural areas as an instrument for social and economic development.(7) Improved links between rural and urban areas are especially important in this regard. Inter-urban trunking facilities, which permit telecommunications transactions of various kinds between major urban centres, typically do exist and there are usually links with international trunking facilities, at least from the capital city.

An important point to stress in this discussion is that quantity of service is only one part of the equation, the other being quality and range of service. Existing plant in many developing countries is of a technological vintage and quality that makes computer flows, i.e., data flows, impossible. Moreover, it is frequently the case that the telecommunications system is subject to frequent breakdowns, interruptions of service, noise or static interference and congestion problems. These problems are serious ones for voice telephony and have major implications for subscribers' willingness to use the

telephone. For data transmissions, however, they are not tolerable at all.

The relative state of a country's telecommunications development has been shown to be highly correlated with the country's relative level of economic development.(8) It is not clear, however, what such a correlation proves. Certainly, the correlation results, in themselves, do not prove that there is a causal relationship between telecommunications development and economic development nor, if there is a causal relationship, in which direction it flows. The results simply confirm that a country's relative level of economic development and relative level of telephone development have historically gone together.

Some observers have maintained that a reliable, good quality telecommunications system is a necessary requirement for economic growth.(9) This assertion, however, has yet to be proven in a definitive quantified way. If it is true, this still does not mean that telecommunications investment (and use) is a precondition to growth.

If we distinguish three broad categories of countries, low-income, middle-income, and high-income (developed), it would appear that the ability to benefit from the provision of telecommunications services is likely to be greatest for the second and third categories. In other words, the low-income countries, because their telecommunications infrastructure is so poorly developed and because the

majority of citizens are outside the modern sectors of the economy, may be badly positioned to realize significant benefits from telecommunications. There is, however, a certain circularity in this argument: telecommunications can't help if it isn't there or if most citizens are not positioned to use it for economic gain but, if it was there, it could be used and it could assist in various ways in leading more citizens into the modern sector or in modernizing parts of the traditional sector.(10)

If low-income countries can break out of this "chicken and egg" situation, they could find that telecommunications is of major benefit. But the problem is more complex than this. Low-income countries often lack the financial capability to undertake major investments in telecommunications, expecially when the priority of the telecommunications sector is contrasted with the priority of meeting such basic needs as health care, food, housing, education, etc. Again there is a circularity in the argument: such needs as food, housing, and medical care do not allow for major investments in telecommunications at the same time as telecommunications, if present, could assist greatly in improving the productivity and/or cutting costs in all of these sectors.(11) What is needed for the low-income countries is assistance for the telecommunications sector from donor-country

aid agencies and international aid and lending institutions. These bodies have, however, traditionally placed a relatively low priority on telecommunications projects in developing countries. The World Bank, for example, has directed only 3% of all loans between 1960 and 1980 into telecommunications projects.(12)

As the MacBride Commission notes:

> Aid for development of communications is still not regarded as a priority matter.... In recent years the importance of communications for development has been constantly stressed both at the political and technical levels... Nevertheless, this recognition has not been reflected in assistance to communication projects... There has been no substantial progress.(13)

Middle-income developing countries are much better positioned to take advantage of the development benefits of improved telecommunications. Industrializing nations such as Formosa or Korea are typified by a highly concentrated industrial structure supported by a dense network of small scale subcontracting establishments. These nations are highly integrated into the world economy, creating a substantial demand for timely and accurate information about distant economic events. Extensions of the network may, in addition, assist in national market integration and production coordination among small-scale independent firms. In other words, where an interdependent market economy is already established, telecommunications can more readily expand this interdependence and its concomitant benefits in terms of growth. Where telecommunications penetration is high enough that its use

is normal or commonplace for more than a select minority (the urban, business/government elite in low-income countries), then its impact as an agent for social change may be appreciable.[14] With a sufficiently high penetration ratio that one can depend on using a telecommunications network to gain access to most potential contacts, the use of telecommunications will have a high value.[15] Middle-income developing countries are advantageously positioned relative to these criteria.[16]

Most of the preceding discussion relates to telecommunications in general and to basic telephone service in particular. Because penetration rates are as low as they are in developing countries; because the quality of basic service is so poor relative to the average quality of service in developed countries; and because access is so often biased towards a select, urban minority, the literature has typically been more concerned with the benefits of extending/improving basic voice-service telephony than with more "sophisticated" teleprocessing applications. Two points should, however, be made:

1. Teleprocessing represents a different class of telecommunications service than voice-service but this does not alter the basic benefits which can be realized. To the extent that a different class of service is added, the aggregate benefits of the total telecommunications network will increase.

2. Teleprocessing applications may specifically increase the benefits of telecommunications by:

   a) generating new information flows[17]

   b) substituting teleprocessing for voice-telephony or other modes of information-transfer, i.e., providing a more efficient means for conveying existing information flows[18]

   and

   c) augmenting or deepening the content of existing information flows.[19]

Teleprocessing may also present more problems for developing countries than voice telephone service. More specifically, teleprocessing

   a) is an even more capital-intensive technology than basic telephony, while developing countries are, on average, relatively labour-intensive

   b) requires much higher skills from users, which may pose problems for developing countries given their scarcity of highly trained personnel and their relatively high levels of illiteracy[20]

c) raises issues of national sovereignty[21] and

d) presents greater foreign exchange problems, since not only is there little manufacture of telephone equipment in developing countries to begin with but the very sophisticated equipment required by teleprocessing (including the computer(s)) is both more costly and even less likely to be manufactured locally.[22]

The implications of these problems could be considerable. For example, as Sesay points out,

> Telecommunication programmes in developing countries depend substantially on foreign technology, since only a few countries can afford telecommunications manufacturing facilities. They also depend on foreign help for planning, senior personnel for key posts, the supply of basic equipment, installation and maintenance.[23]

In countries where labour utilization rates are already extremely low, technology which is highly capital-intensive, import-intensive and dependent on expatriate personnel may have significant social costs. If this problem is found with basic telephone service, as Sesay argues above, it will be even more pronounced for teleprocessing. Moreover, there is a much greater level of training/expertise required of users with teleprocessing systems as distinct from basic telephone systems. One of the advantages of telephone service which is often cited is that it is an oral communication medium,

which makes it compatible with the oral tradition of the culture of many developing country societies and provides a way of bypassing the obstacle to written forms of communication posed by illiteracy.(24) Teleprocessing, however, does not necessarily have this advantage. In certain forms, videotex for example, it may be very user-friendly.(25) But in general it requires specially trained operators/programmers. At the very least, the alphanumeric character set of computer language moves away from the oral trait of voice telephone service and electronic broadcast services.

While the skilled labour requirements (technicians, programmers, etc.) of teleprocessing may be a problem, teleprocessing applications may offer significant relief to the development constraint imposed by skilled manpower limitations in other sectors of the economy. The greatest economic advantage of teleprocessing (and telecommunications in general) is the increased productivity which it allows. This productivity effect operates not only at a macro-level but at a micro-level. Indeed the macro-level impact on productivity is the sum of the micro-level effects. Developing countries face shortages of skilled professionals and senior administrators in all sectors. Teacher, doctors, lawyers, planners, accountants, economists, engineers, managers, as well as computer scientists

and computer technicians, are all in short supply.[26] This constraint places severe limits on the absorptive capacity of government ministries, government agencies, para-statal bodies, and private business operations. It impedes the delivery of universal minimum levels of health care and education. It is often a central factor in the success or failure of major development projects.

Teleprocessing offers tremendous gains in the productivity of these scarce personnel. First, it permits many "routine" functions to be handed over to the computer, thus giving senior personnel more time for decision-making, policy determination, problem-solving, etc. Second, it permits much more efficient control, with considerable savings in personnel time, in monitoring of decentralized operations; telecommunications provides a substitute for time-consuming travel.[27] Third, it can augment the real or effective stock of professionals by providing multi-point access to them; in the health sector, for example, telemedicine networks allow a relatively small number of doctors located in a regional centre to "service" a wide network of clinics which, themselves, are staffed by para-medics.[28] Fourth, these professionals and managers can make direct use of teleprocessing to improve their efficiency; computer-aided-instruction in the education field, for example, can potentially increase teachers' productivity/efficiency quite significantly.[29]

Through all of this discussion it is important to realize that the essential service, and the source of resulting benefits, of teleprocessing is delivery of information, efficiently,

quickly and in large quantities. We know relatively little about the role of information in the economy and society.(30) This is because the traditional focus of economics and sociology has been on man and the physical environment, on material well-being. Information, however, is clearly an essential input in the production process for all sectors, not just those industries which directly produce information services. This is now being increasingly realized, in part, because teleprocessing technology and applications have caused information to be more clearly recognized as a good and as a factor of production. To quote Eger,

> We have become increasingly dependent upon these various forms of information for the growth and health of the economy, the smooth functioning of institutions, and the quality of our individual lives. In simple terms, information has become a marketable, transferable, exportable commodity--a commodity for production, sale, and consumption with which more and more of us are engaged every day.(31)

In many cases, however, the motivation which seems to be propelling government interest in information goods and services is one of fear rather than optimism. The fears are not unwarranted. We have already noted some of the problems for developing countries, namely:

1. increased dependence on foreign technology
2. increased dependence on foreign personnel
3. the disadvantages of a capital-intensive technology in labour-abundant economies
4. foreign exchange problems owing to the high import intensity of the system hardware

5. fears of encroachment on national sovereignty, of a new "electronic imperialism".

To this list of items we have already mentioned we might now add:

6. fear of job displacement effect
7. fear over possible invasion of privacy (either of individuals or collectivities)
8. increased vulnerability from dependence on external (to the country) sources of information and information storage
9. the erosion of national boundaries by global communications networks
10. balance of payments problems resulting from payment for imported computing services
11. reduced autonomy for branch plant/subsidiaries of multinational corporations and reduced ability to police the financial accounts of such companies, since these need no longer be kept in the country in which the business is located
12. reduced profits for PTT's owing to the greater use of leased lines, independent satellite-based systems, and other privately owned transmission systems.(32)

This is a formidable list. Some of the problems may be greatly overestimated, but they are all legitimate from the

vantage point of the countries involved. It is not only the developing countries who have these concerns. Most developed countries are, in fact, debating these matters far more than most developing countries.(33) Indeed, the way in which developed countries seem to be acting to insulate their own economies/societies/cultures while trying to maintain unrestricted access to the markets of developing countries is perhaps one of the principal reasons for concern by developing countries.

Although the potential problems posed by teleprocessing are important, it must be remembered that there are also benefits to be realized from teleprocessing applications. It is very important that concerns over possible abuses of teleprocessing be addressed and that such abuses be minimized. Countries should not, however, impose such severe restrictions that the benefits of teleprocessing are unnecessarily lost or foregone in the process. The optimal policy is one which, simultaneously, seeks to maximize benefits and to minimize costs.

This report has already noted many of the benefits, actual or potential, of teleprocessing applications in developing countries. Few specific examples have been cited, partly because the literature detailing applications in developing countries is very sparce; partly because the level of development of the telecommunications infrastructure is so relatively low that the actual applications to date are relatively

inconsequential when considered against the potential applications which would be possible with a fully-developed, appropriately designed national telecommunications network; and partly because the use of computers is still relatively low.

As of 1977, according to estimates made by the MacBride Commission, 95% of the world's computer installations (expressed in value terms) were located in the industrialized countries; only 5% were found in developing countries.[34] These figures do not necessarily represent the proportional use of computers between the two groupings since developing countries can, and do, make use of computer installations outside their own boundaries. The figures are, however, illustrative of the extreme imbalance in computer resources and computer use between developed and developing nations.

Within the developing country group, there are, nonetheless, many examples to be found of teleprocessing applications. A partial listing of these includes such areas as: banking[35], commodity markets[36], meteorological forecasting[37], distance-education[38], transportation[39], inventory systems[40], land use planning[41], mining exploration[42], health care[43], environmental planning[44], forest management[45], oil pipeline management[46], and so on. The principal users in these cases are governments and large corporations, the latter very often being subsidiaries of multinational corporations.

A number of individual countries also stand out in terms of their relative use of computers and/or tele-processing applications. Taiwan, which has a very high level of telecommunications development, has a well developed group of data communications users.(47) The telecommunications administration currently is proceeding with the planned introduction of a packet switched data network in 1982, including a dial-up capability, to replace the present system for data service which is provided mainly by tie lines.(48)

The Philippines has experienced a large increase in demand for data transmission channels over the last several years.(49) But the telecommunications administration has been unable to adequately respond to this increase in demand because of "lack of proper data transmission circuits which can be switched between the central computer and the remote data terminals."(50) To resolve this problem the Philippines is setting up a "Switched Digital Data Communications Network." Initial service will be provided in Manila, followed by two other urban centers. In the longer run, a full national network is planned.(51) The major customers expected to make use of the data network include "banks; industrial companies with disperse operation; government departments and defense; universities and research institutes; hospitals; airlines and shipping companies; hotel and travel industry; [and] retail companies."(52)

In Venezuela, the market for computers has been growing at an annual rate of 27%.[53] In 1977, Venezuela had 600 "large" central processing units installed. Of these 65% were used by private firms and 35% by government. The banking and petroleum sectors of the economy are particularly important private sector users.[54]

In several other Latin American countries, notably, Argentina, Brazil, Chile, Colombia, and Mexico, (in addition to Venezuela), major expansion of telecommunications services, including data transmission services, is underway or planned.[55] Electronic data processing is regarded, for all of these countries, as being "at the threshold of expansion."[56]

There is a great deal of emphasis currently being placed on telecommunications development in many other developing countries. In many cases, this involves an upgrading of existing facilities along with an extension of service to new areas. The hardware technology being used in these new facilities will, typically, provide greatly improved data transmission capability. Thus, even where the demand for data transmission services has not yet grown significantly, an improved capability for data transmission will be available when and if the demand does emerge. In many instances, as illustrated by some of the above examples, the demand for data transmission services is already present and has been important to the decision on upgrading and equipment choice.

There are many examples of developing countries which

are pursuing major telecommunications expansion programmes which will provide a greatly enhanced data transmission capability. To name just a few of these, in addition to those already noted: Saudi Arabia is in the midst of a massive expansion/upgrading of service, which will result in Saudi Arabia having one of the most advanced, modern telecommunications systems in the world[57]; India is soon due to begin service of a national satellite service[58] and is evolving a plan for a public data network[59]; Mexico is involved in a major expansion programme, in conjunction with an effort to develop a greater equipment manufacturing capability[60]; and Indonesia has already introduced a domestic satellite service[61].

Although there is a growing interest in public access data networks, as shown by some of the examples noted earlier, most teleprocessing systems in developing countries are privately operated. Leased, dedicated line facilities or channel capacity may be obtained from PTT's but there are, in general, no public access data networks.[62] The quality of the voice-grade public switched network is often not good enough for data applications. This is significant for several reasons:

1. without public access networks and computer time-sharing arrangements teleprocessing applications in developing countries will remain in the hands of large institutions (government, multinationals, banks, etc.); the technology will not be diffused throughout the economy, thereby losing the benefits potentially realizable by medium/small-sized institutions,

2. leased lines which are priced on the basis of cost generate proportionately less revenue for PTT's than regular telephone service which is priced on a volume-sensitive or value-sensitive basis. If public data networks replaced leased lines or if the latter were priced on a volume-sensitive basis versus a cost-based flat fee, PTT's would gain considerable revenue. PTT's have clearly recognized this fact.(63)
3. Leased, private lines restrict the range of possible contacts which can be made. While this may be of little importance to individual networks/users, it may be of major significance for the country at large. The total network becomes fragmented and the exchange of information takes place only within closed pre-defined channels.
4. Following particularly from 3., leased lines which leave such important information channels in the hands of a select few create the possibility of an "information elite". While it is not clear that this is necessarily bad, it does contradict certain egalitarian principles which most governments at least nominally support.
5. Public networks would, potentially, make it easier to control external (to the country)

data transmissions, both incoming and outgoing traffic.

A strong case can be made for provisioning public access networks in order to maximize the range of teleprocessing applications and the range of teleprocessing users. Leased lines do siphon-off a significant portion of the revenue base otherwise available to such systems and could forestall the introduction of public networks. On the other hand, private institutions must obviously be concerned with the availability of transmission lines when needed, and with the integrity of the lines, both in technical terms and in terms of confidentiality/privacy concerns. The quality of service and the maintenance record of PTT's in developing countries, on average, is not particularly reassuring to these concerns.

Perhaps one of the greatest causes of concern over teleprocessing on the part of developing countries is the relatively high use of such networks by multinational or transnational corporations. For these companies, teleprocessing makes it possible to maintain all records of the subsidiary in a computer installation outside the country without interfering with the subsidiary's own access to the records. This creates the possibility of evading country regulations regarding taxes, trade relationships, local suppliers, trade controls, foreign exchange controls, etc.

There can be no question that multinational corporations gain tremendous benefits from setting up teleprocessing networks amongst their various offices in various countries. The

question is whether national sovereignty is eroded in the process and how to keep this from happening without losing the economic benefits of teleprocessing. As Cundiff has noted,

> Major multinational companies increasingly rely on computer communications as a form of "nervous system" for the coordination of functions in the corporate body... the uninterrupted movement of corporate data and the freedom to process data where it best serves the company are of key importance to corporate performance... International conflicts will most surely increase as more and more nations undertake to build barriers to the free flow of computer data... It is the developed world which has built the technological infrastructure of sufficient strength to become self-reliant in computer communications in the 1980's. With the exception of countries such as Saudi Arabia, soon to be the first nation with all-computerized telephony, most of the Middle Eastern, Asian, and African countries are at the mercy of the developed nations to transfer computer communications technology.(64)

To this may be added the following statement by Crawford,

> It is essential that international accommodations be sought that will provide reasonable satisfaction for national information interests. Such accommodations must not inhibit the application and development of computer communications technology. Computer communications technology should be viewed as today's most dynamic and effective factor of production and be fully recognized for its contributions to improvements in the welfare and well-being of all nations.(65)

The above statement by Cundiff draws attention to an important distinction that must be made between content and hardware.(66) Several of the problems posed by teleprocessing networks are related to hardware: the need for skilled operators; the high capital-intensity of the technology; the high import-intensity of the technology; the implications of leased lines for the revenue base of the PTT; and the increased

dependence on foreign technology. On the other hand, several of the problems posed by teleprocessing networks are related to content, to the information which is conveyed: increased centralization of records and management by multinational corporations; job displacement effects; balance of payments impact of imported computing services; the erosion of national boundaries; privacy concerns; and access concerns. These categorizations are not absolute but do stand up as an approximation.[67] What they suggest is that, if there are two classes or types of problem, then, perhaps, there are two classes or types of solutions which must be sought. The hardware class of problems are, in general, the same problems as are posed by a great many goods imported by developing countries. They are not unique, in general, to teleprocessing. In the long term, they are surmountable, if the resource cost involved in implementing solutions warrants such action. Local manpower can be trained; domestic manufacturing can be undertaken; and overall growth will generate employment. To the extent that it is not economically viable to pursue such strategies as local equipment manufacture, the essential question will be whether the benefits of using the technology outweigh the costs as they are.

On the other side, the content problems are really quite different. In a different sense than for the hardware problem, they are also not unique to teleprocessing, per se. All of

the questions relating to external data flows, for example, are really questions relating to the net benefits of multinationals. What must be realized is that teleprocessing applications are used by multinationals because it makes the production and conveyance of information cheaper and easier; it does not, however, create the information requirement and it is not the only means of conveying the information.(68) This is not meant to imply that teleprocessing does not alter corporate structure and management practices. What it does imply is that the issue for countries to decide is the desirability of multinational corporations (in general or on a case-by-case basis) rather than just the desirability of teleprocessing by multinationals. In similar fashion, it is not clear that the vulnerability which arises from dependence on external sources of information or data base storage outside of a country is any different than the vulnerability which comes from dependence on external sources of food or land shipments of goods which pass through other countries.

To solve the problems presented by teleprocessing by excessive restrictions on teleprocessing itself would be rather like killing the messenger who brought bad news. Teleprocessing has made information a global commodity of major prominence and information services a major trade item. Because information has, historically, not been viewed in these terms, the problems are viewed as unique and attention is too narrowly focussed on the technology. What is required is an understanding of information as a commodity and the specification of the appropriate

property rights which accompany it. Efficiency must be traded-off against a country's social/ethical values when these conflict, in order to reach agreement on the property rights specification.

This discussion is not unique to developing countries, as has been previously noted. But, in many respects, the stakes are much higher for developing countries. The costs are potentially higher but so are the benefits. To the extent that "information is power", the developing countries cannot afford to forego the technology. At a more specific level, teleprocessing can offer significant benefits for economic and social development goals of developing countries. It is perhaps appropriate to offer a review of these benefits by way of conclusion to this section.

1. Teleprocessing may improve the efficiency, i.e., the productivity, of other factors of production, through providing greater flexibility in the siting of firms within a country which are not otherwise "tied" to a particular location[69]; through improved use of relatively scarce labour sub-groups, most particularly highly skilled professionals and management personnel[70]; through improved performance of other infrastructure components such as transport services and power utilities[71]; and

through improved rates of capital utilization as a result of more efficient planning of the production cycle owing to improved information flows.[72]

2. Teleprocessing may expand the effective market area of business firms, giving rise to more efficient plant sizes and economies of scale, through allowing more efficient, quicker, and higher volume information flows between regional offices/representatives and head-office management; improved inventory control systems; improved ordering of spare parts (where this is applicable), and, in general, improved responsiveness to all customer needs.[73]
3. Teleprocessing may reduce the cost of information-transfers for business firms. This effect, to be realized, may depend on the scale of information flows undertaken, although this is not necessarily the case.[74]
4. Teleprocessing may enable significant reductions in inventory holdings by permitting a centralization of inventories through the establishment of an automatic data processing link between all sales locations and a central inventory depot versus maintenance of a multi-depot inventory system. For medium-and

small-sized firms, the ability to realize this benefit may depend on the availability of a public-access network with computer time-sharing; otherwise, the computer and communications costs of a totally self-owned/leased system are likely to outweigh the cost savings which can be realized.[75]

5. Teleprocessing may permit significant improvement in the delivery of government services; in the profitability of government-run enterprise; in the efficiency of senior government personnel; in the level and ease of information exchange by different levels of government in the same country; for certain types of teleprocessing, in the delivery of information to citizens[76]; and, where otherwise desired, in the decentralization of government offices. Of particular note regarding improved delivery of government services are telemedicine and distance-education applications of teleprocessing in the health-care and education sectors respectively.[77]
6. Teleprocessing may improve the performance of security-related agencies through, for example, remote sensing applications for monitoring of weather, natural disaster warnings, forest fires, etc.[78]

7. Teleprocessing may promote social development indirectly as a spin-off of the economic benefits noted above and directly, through its use in delivering health-care and education services and in promoting inter-community interaction, especially the exchange of information by local governments.(79) Of particular relevance is the impact teleprocessing can have on the decentralization of economic activities in both the private and public sectors by either creating a necessary condition for firms to expand their operations in certain areas or making it more cost-effective and hence feasible for governments to induce such decentralization. One of the major problems of many developing countries is severe urban congestion, especially in capital cities, with its attendant problems of high urban unemployment, housing shortages, sanitary/health problems, etc. Planned decentralization out of the capital of private enterprise and public sector offices is desirable, to stem and, ideally, reverse the rural-urban migration which has created and continues to add to this urban congestion problem.(80)

In general, it is very important to realize that the potential overall benefits of teleprocessing are not simply the sum of expected private benefits of users. The indirect benefits noted in the above list may be extremely important. It is these benefits which must be investigated and emphasized as developing countries consider the relative merits of introducing teleprocessing networks and applications. As Blackman has noted,

> It is not the telecommunications system that makes the contribution to economic growth; rather it is the utilization of the system by sectors contributing to Gross Domestic Product.(65)

Footnotes:

1. "Telecommunications: a survey--The born again technology", The Economist, August 22, 1981, p. s22.

2. ITU Yearbook, 1978; ATT World Telephones, 1978.

3. Ibid.

4. Ibid.

5. B. Wellenius, "Telecommunications in Developing Countries", Telecommunications Policy, September 1977.

6. See, for example, H. Hudson, et. al., The Role of Telecommunications in Socio-Economic Development: A Review of the Literature with Guidelines for Further Investigations, (Keewatin Communications, May 1979).

7. See, for example, H. Hudson and E. Parker, "Economic and Social Development Benefits of Rural Telecommunications", Workshop on Special Aspects of Telecommunications Development in Isolated and Underprivileged Areas of Countries (Ottawa: Department of Communications, Government of Canada, 1978), p. 273.

8. See, for example, P. Shapiro, "Telecommunications and Industrial Development", IEEE Transactions on Communications, COM-24, 3, 1976; D. Marsh, "Telecommunications as a Factor in the Economic Development of a Country", IEEE Transactions on Communications, COM 24, 7, 1976; CCITT, Economic Studies at the National Level in the Field of Telecommunications, (Geneva: ITU, 1973). For a critical review of these papers, see H. Hudson, et. al., op. cit., pp. 29-34. Also see A. Hardy, The Role of the Telephone in Economic Development, unpublished Ph. D. dissertation, Stanford University, 1980.

9. See, for example, B. Wellenius, "The Role of Telecommunications Services in Developing Countries", Workshop on Special Aspects....(op. cit.), p. 26.

10. Tyler, for example, discusses the possible impact of telecommunications in bringing the traditional agricultural sector into the commercial agriculture sector. See M. Tyler, "The Evaluation of Telecommunications Programs and Projects in Less Developed Countries", in P. Polishuk and M. O'Bryant, Telecommunications and Economic Development, (Dedham: Horison House, 1977).

11. For a discussion of the literature on the benefits of telecommunications re agriculture, health care, education, etc., see H. Hudson, et. al., op. cit.

12. This figure is quoted in The Economist, op. cit., p. s22.

13. S. MacBride, et. al., Many Voices, One World, Report by the International Commission for the Study of Communication Problems, (Paris: UNESCO, 1981), p. 221.

14. For a discussion of telecommunications as an agent of social change see H. Hudson, et. al., op. cit., pp. 46-49. Also for a more economics-based discussion of so-called "trait making" characteristics of telecommunications, see A. Hirschman, Development Projects Observed, (Washington: Brookings Institution, 1967).

15. This point is related to the concept of network externalities. For a discussion of this concept, see R. Artle and C. Averous, "The Telephone Systems as a Public Good: Static and Dynamic Aspects", The Bell Journal of Economics and Management Science, 4, 1, 1973; L. Squire, "Some Aspects of Optimal Pricing for Telecommunications", The Bell Journal of Economics and Management Science, 4, 2, 1973; and J. Rohlffs, "A Theory of Interdependent Demand for a Communications Service", The Bell Journal of Economics and Management Science, 6, 1, 1975.

16. This discussion draws on B. Lesser and L. Osberg, The Socio-Economic Development Benefits of Telecommunications, a report prepared for the ITU (Halifax: Dalhousie University, 1981).

17. For example, teleprocessing might permit the use of a computerized reservations system by an airline that was accessible by agents in dispersed locations. New information flows would result insofar as all the reservations information would be available to any agent. Without immediate access to this information on a computer terminal, agents would not typically request it. The advantages or benefits to be realized are the ability to immediately confirm reservations, advise agents of space which has been freed, identify demand patterns as an aid to scheduling, etc.

18. A bank in Kenya, for example, maintains a 30-vehicle fleet to bring daily reports from rural branches to its computer centre in Nairobi at the end of each day's business. It cannot use teleprocessing to gather this information because the telephone network does not exist. On-line terminals for direct data transmission would, quite obviously, be a far superior option.

19. The information content of a message relates both to what is in the message and the timeliness of the information. Last week's stock market report may be of little advantage to a trader in today's market. Teleprocessing can send more information faster than alternative information-transfer modes.

20. See MacBride, et. al., op. cit., Part II, Chapter 5.

21. See, for example, J. Eger, "The International Information War", Computerworld Extra, XV, 11a, March 18, 1981.

22. See MacBride, et. al., op. cit., pp. 213-214.

23. S. J. Sesay, "Some Problems of Improving Telecommunication Systems in Developing Countries", in Polishuk and O'Bryant, op. cit., p. 125.

24. See A. Hirschman, op. cit.

25. For a discussion of videotex and its characteristics, see for example, D. Godfrey and D. Parkhill (eds.), Gutenberg Two, (Victoria: Press Porcepic, 1980) and D. Godfrey and E. Chang, The Telidon Book, (Victoria: Press Porcepic, 1981).

26. A recent report of the World Bank notes, for example, that "faster economic growth in Africa requires accelerated development of human resources." (The World Bank, Accelerated Development in Sub-Saharan Africa, (Washington, 1981), p. 81.). This Report elsewhere notes, "highly trained technicians, professionals, and managers remain in very short supply", (p. 15); and "One of the most critical problems of the past 20 years has been the scarcity of trained manpower", (p. 9).

27. For a discussion of the telecommunications/travel trade-off see, for example, J. Nilles, et. al., The Telecommunications Transportation Trade-Off, (Baltimore: John Wiley, 1976).

28. Hudson, et. al., (op. cit.) provides a detailed discussion of telemedicine services.

29. For a discussion of CAI, see D. Godfrey and D. Parkhill, op. cit. For a more general discussion of "distance-education", see Hudson, et. al., op. cit. See also, MacBride, et. al., op. cit., pp. 25-29.

30. For a discussion of the role of information in economic and social processes, see Lesser and Osberg, op. cit., Appendix 2.

31. J. Eger, op. cit., p. 104.

32. These issues or concerns are all touched on by Eger, op. cit. Also see MacBride, et. al., op. cit., passim.

33. For an example of this debate in a Canadian context, see Consultative Committee on the Implications of Telecommunications for Canadian Sovereignty, Telecommunications and Canada, (Ottawa: Supply and Services, Government of Canada, 1979). Eger, op. cit., summarizes some of this debate for Japan, the U.S., and the EEC.

34. MacBride, et. al., op. cit., p. 130.

35. See footnote 17.

36. This is especially relevant at the level of international commodity markets. Para-statal marketing agencies in various countries are establishing computer-communication links to commodity markets in Europe and North America.

37. See, for example, J. Labrousse, "The Data Exchange Network of the World Meteorological Organization", Telecommunications Journal, 43, VIII, 1976.

38. See footnote 26. Also, see G. Benstead, USP Satellite Communication Project: Report for the Experimental Years 1975-76, (Suva, Fiji: University of the South Pacific Extension Services, 1977).

39. See, for example, H. Kullenberg, "Application of Computer Communications in the Air Transport Industry" (mimeo)

40. For a discussion of the benefits of computerized central inventory control systems see Lesser and Osberg, op. cit., Appendix 5, pp. 15-19.

41. See, for example, the discussion of Latin American experience with remote sensing from satellite in Report of the United Nations/Food and Agriculture Organization Regional Training Seminar on the Applications of Remote Sensing from Satellite, La Paz, Bolovia, December 1977.

42. Ibid.

43. See footnote 25. Also, for a discussion of a specialized "biotelemetry" service in India see "Telecommunications and Health", Telecommunications Journal, 48, V, 1981, p. 235.

44. See footnote 37.

45. Ibid.

46. J. Third, et. al., "Telecommunications System for Oil Pipeline in Pakistan", Telecommunications, (N.A. ed.), Jan. 1982.

47. P.C. Chen, "The Growth and Development Plans for Telecommunications in Taiwan", Telecommunications, (N.A. ed.), June 1981, p.29.

48. Ibid.

49. W. Clavecilla, "The Philippines' First Data Communications Network", Telecommunications, (N.A. ed.), August 1980.

50. Ibid., p. 41.

51. Ibid.

52. Ibid., pp. 41-42

53. J. Uzenda, "Latin America: A Mini Look at Major Markets", Telecommunications, (N.A. ed.), Jan. 1980, p.20.

54. Ibid., p. 20.

55. Ibid., p.19. See also M. Garfinkle, "Argentina's Telecom Movement", Telecommunications, (N.A. ed.), March 1982.

56. Ibid., p. 19.

57. "Telecommunications in the Kingdom of Saudi Arabia, Telecommunication Journal, 47, 3, 1980.

58. P. Kale and D. Graul, "India's Multi-Purpose Satellite", Telecommunications (N.A. ed.), Nov. 1980.

59. P. Verghese, "Telecommunication Operations", Telecommunication Journal, 46, 2, 1979, p. 97.

60. A. Serrano, "Microwave Solid-State R & D in Mexico", Telecommunications, (N.A. ed.) Jan. 1982.

61. J. Tengker, "Special Technical Problems of Planning Telecommunications Services in Isolated and Underprivileged Areas", in Workshop on Special Aspects of Telecommunications Development in Isolated and Underprivileged Areas of Countries, (Ottawa: Department of Communications, Government of Canada, 1978).

62. J. Eger, op. cit.

63. At a 1977 meeting of the CCITT, Italy introduced a motion to eliminate private leased lines. This was not passed but is indicative of the PTT attitude on this issue. See Eger, op. cit., pp. 108-109. The European PTT's, it should be noted, are the strongest advocates of this position, more so than the PTT's of developing countries. This is most likely related to the high initial cost of establishing a data network, given the more limited resources and lower level of network development for this latter group.

64. W. Cundiff, "Issues in Canadian/U.S. Transborder Computer Data Flows", in W. Cundiff and M. Reid (eds.), Issues in Canadian/U.S. Transborder Computer Data Flows, (Montreal: IRPP, 1978), pp. 13 and 30.

65. M. Crawford, "Position Statement", in Cundiff and Reid, op. cit., p. 74.

66. This distinction is also made by Eger, op. cit.

67. In other words, many of the problems we have listed reflect both hardware and content dimensions. The categorization suggested here is based on which of these seems to be the dominant nature of the problem.

68. See, for example, Price Waterhouse Associates, A Review of the Economic Implications of Canadian Transborder Data Flows, (Toronto: 1981), pp. 13-14.

69. See, for example, M. Tyler, op. cit.

70. See, for example, ITU, Appropriate Modern Telecommunications Technology for Integrated Rural Development in Africa, Part II: Background Report, (Geneva, Nov. 1981), Chapter 5.

71. See, for example, G. Beaudoin, "Transmission Requirements for a Communications System of an Electric Power Utility", in Polishuk and O'Bryant, op. cit., pp. 451-454.

72. See, for example, ITU, op. cit.

73. See, for example, Lesser and Osberg, op. cit., Appendix 5, pp. 12-15.

74. See, for example, B. Lesser, "On Assessing the Benefits of Telecommunications: Some Proposed Methodologies", a paper presented at the Expert Meeting on Telecommunications and Development, sponsored by ITU/OECD, Paris, 1978.

75. Ibid., pp. 15-19. Also ITU, op. cit.

76. See, for example, D. von Sanden, "A Public Global Telecommunication Network for Voice, Text, Picture and Data Transmission", Telecommunication Journal, 47, IV, 1980.

77. See, for example, E. Parker, "Economic and Social Benefits of the REA Telephone Loan Program" (working paper, March 1981); ITU, op. cit.; Hudson, et. al., op. cit.; and Tyler, op. cit.

78. See, for example, Lesser and Osberg, op. cit., Appendix 5; Report of the United Nations, op. cit.; and C.R. Dickenson, "Telecommunications in Developing Countries - The Relation of the Economy and the Society", in Polishuk and O'Bryant, op. cit.

79. See H. Hudson and E. Parker, "Telecommunication Planning for Rural Development", IEEE Transactions on Communications, COM-23, 10, 1975, pp. 1181-1182.

80. See M. Tyler, op. cit., p. 97.

81. See C. Blackman, "Telecommunications for Economic Development in the Lower Income Countries", in Polishuk and O'Bryant, op. cit.

PART II

The Status of Teleprocessing in Canada

Introduction

Teleprocessing may be defined as data processing where the input and/or output devices are in a different location than the computer or central processing unit. More generally, it may be defined as the combined use or application of computer and telecommunications services. As such it encompasses a wide variety of services, ranging from conventional data transmissions to remote sensing to videotex service. Not all of these possible applications are to be found in every country, at all or in the same degree. Between countries there may be marked differences in the institutional structures which have been set up to provide teleprocessing services and in the hardware and hardware configuration used for teleprocessing applications. The teleprocessing experience of each country, thus, typically has certain unique characteristics (or combinations of characteristics). The study of individual country experiences with teleprocessing may, therefore, be of great value to others who are seeking alternative ways of structuring teleprocessing services and their delivery, exploring alternative hardware options, or seeking a better understanding of the impact/implications of teleprocessing. This section examines aspects of the teleprocessing experience

of Canada, with particular emphasis on the relevance of the Canadian experience to date for developing nations.

The Canadian Political/Economic Framework

Canada is a federal state, made up of ten provinces and two territories. There is a federal or national level of government and a provincial level of government in each province. The respective powers and responsibilities of each level of government are defined by the constitution, as interpreted by the courts over time. The two territories are administered under federal jurisdiction.

The system of government in Canada is that of a parliamentary democracy. The official head-of-state is the British monarch whose day-to-day role is carried out by the Governor-General of Canada at the federal level of government and ten Lieutenant-Governors, one in each of the provinces. Each of the provinces has an elected legislative body, as does the federal government, which also has an upper house, called the Senate, whose members are appointed.

The economy of Canada is best described as a "mixed" economy. It is predominately a market type system but government plays a substantial role through legislative curbs on private market practices, direct regulation of certain industries (including most of the telecommunications sector) and direct ownership. This is the case at both the federal and provincial levels of government.

Historically, Canada's economy has been oriented towards the export of primary products. Primary products are still a central focus of Canadian economic activity. Secondary manufacturing, historically and at present, has been mainly domestic market oriented. The service sector of the economy has been the fastest growing sector, in terms of employment, since the 1920's, and this trend has accelerated in the last two decades, particularly in so-called "information occupations".(1)

Canada is a very open economy, with imports and exports both, on average, well over 30% of GNP. Canada also has a very high proportion of foreign investment/ownership in all sectors of the economy and especially in the secondary manufacturing sector. Canada's major trading partner is the United States, which is also the principal source of foreign investment and foreign ownership in Canada.

Over the 1970's, the Canadian economy, on average, did not perform that well. Real growth rates were relatively low, compared to the post-war period as a whole, and much of the decade was marked by the occurrence of simultaneous recession and inflation. Although Canada is an oil-producing nation, the global increase in oil prices which began in 1973 seriously affected the performance of the economy in the 1970's. Because the eastern portion of Canada does not have access to Canadian oil produced in the western portion of the country, which is where most of the present producing reserves are located, Eastern Canada is a large oil importer.

New discoveries of offshore oil and natural gas on the Atlantic Coast promise a longer term solution but these fields are unlikely to be in production for several years.

Despite the economic problems of the past decade, Canada's economy is relatively strong and prospects for the future are promising. The vast resource-rich, northern areas of the country still remain to be developed and the technology now exists to make this possible. Similarly, ocean resource development is becoming an increasingly real possibility. Government policy is placing an increasing emphasis on support for "high-technology" industries, in part in order to encourage a higher level of manufacturing exports. This policy is producing some favourable results in selected industries, among which are the computer/telecommunications industries.

The telecommunications Infrastructure

Canada has a highly advanced telecommunications system. The carrier system is a curious mixture of provincial and national companies, private and public ownership, provincial and federal regulation. Although there are still over 300 telephone companies in Canada, most of these are very small and there has been a pronounced increase in concentration over the last sixty years.(2) In 1921, there were 2,365 telephone systems in Canada.(3) Today, although there are over 300 companies, nine companies provide most of the basic telephone service in the country.(4) In addition, Telesat Canada operates Canada's domestic satellite programme, CN/CP Telecommunications operates a national telegraph/telex/data

transmission network, and Teleglobe handles international services outside of North America. The nine major telephone carriers plus Telesat comprise the Trans-Canada Telephone System, a voluntary organization which administers inter-provincial services.

Both TCTS and CN/CP Telecommunications operate digital packet-switched networks for data transmissions.(5) In fact, in 1973, Canada established the world's first digital data transmission system, followed in 1976 by a packet-switched network. As Collins notes, "This [packet-switching] was to data communications, what the telephone network was to voice: a basic route connecting many users to many computers..."(6)

The introduction of digital packet-switched networks in Canada allowed maximum use to be made of an innovation first perfected in 1963 in the computer field: the time-sharing computer. As noted by Beere:

> This ability of one computer to share its time with many input-output devices scattered throughout the U.S. or even the world, was an event of extreme importance to industry. The giant computer facility was within reach of the small businessman, who up to that time could not afford an installation of that magnitude.(7)

Many large users, of course, utilize dedicated lines, which are generally leased from the common carriers. The packet-switched network together with time-sharing computers, however, helped put teleprocessing, and computing activity in general, within reach of middle/small-sized users. They opened the door to maximum participation/access. Packet/switching allowed many users to economically connect to a computer(s) while time-sharing allowed a computer to service many, diverse users.

There is a telecommunications equipment manufacturing industry in Canada. Most of the firms are relatively small in size, however. The most notable exception to this rule is Northern Telecom, which is Canada's largest telecommunications equipment manufacturer.

The Use of Computers in the Economy

The use of computers in Canada is also relatively well developed. In 1965 there were 1,010 computers installed in Canada, covering all sizes of machines.[8] By 1975, there were 15,960 computers of all types (sizes) and by 1985 the estimated total is for 70,200 computers of all types (sizes).[9] In 1975, it has been estimated that Canadian government, business and institutional users spent a total of $2.7 billion on computer/communications services. 95,000 jobs not counting production workers/sales staff of equipment suppliers and staff of the telecommunications carriers were employed in the production of computer/communications services in 1975.[10] A 1978 estimate of expected expenditure levels on computer/communications services in 1980 was $5.6 billion, and in 1985 $9.5 billion.[11] If these estimates prove correct, this will represent almost a four-fold increase over the decade 1975-1985.

The majority of these computer-communications services were provided in-house by the users in 1975. Approximately 20% of the total were purchased from other sources--service bureaus, parent companies, etc.[12] Purchases by Canadian

subsidiaries from foreign parent companies accounted for the greatest share (90% approximately) of imported services, which, in turn, accounted for approximately 30% of purchased computing services.(13) Estimated trends in imported services indicate a rising share of foreign to total purchases through 1985, when the estimated proportion is expected to be 52%.(14) The share of total foreign purchases accounted for by parent/subsidiary sales is expected to decline over this period, however, falling to the 75%-80% range by 1985.(15) These projections assume no changes in the institutional structure of the industry and no changes in government policy.

These figures cover all computing services whether in-house or external (to the firm) and whether telecommunications is actually used. As the report providing the estimates points out,

> today any computing activity can be conducted remotely, and the mix of activities actually conducted remotely is continually shifting with changes in equipment, software and telecommunications facilities and costs.(16)

In other words, because the remote capability is there, virtually anywhere in Canada, given the state of development of the Canadian telecommunications system, a distinction between teleprocessing activities and other computing services would be an artificial distinction.

Canada has a computer hardware manufacturing industry, though Canadian-owned firms in this area tend to be involved

with production of terminal/transmission equipment and generally are relatively small in size. Main-frame computers or parts thereof, are produced in Canada but, in general, by Canadian subsidiaries of foreign multinationals.(17) There is also a Canadian software industry but this too is heavily dominated by imports and/or subsidiaries of multinationals.

Teleprocessing

Teleprocessing applications are found in almost every sector of the Canadian economy. In any industry, computers can be, and are being, used for administrative purposes. And, where computers can be used and the necessary telecommunications infrastructure exists, teleprocessing can be used. Globerman comments as follows, regarding administrative-type data processing in Canada:

> The most straightforward and institutionalized use of EDP [electronic data processing] has been the automation of various accounting functions such as payroll, accounts receivable and payable, and general ledger. The computer is also being utilized in production and process control applications (e.g., materials planning, production scheduling, inventory management); finance functions (e.g., costing, cash-flow analysis); marketing functions (e.g., sales analysis, ordering site analysis); and planning (e.g., forecasting, critical path scheduling). Over time many companies have become involved in integrating computer procedures for their main company functions to provide a total management information system. The components of such systems have one central purpose: to equip management with better information and an enhanced ability to quantify the factors upon which decision making depends.(18)

Computers, and teleprocessing, have to date found limited application in the actual goods production phase of manufacturing. While robotics technology can be expected to increasingly alter the use of computers or computer-technology in production,[19] teleprocessing is likely to continue to be limited in this area. In the process control functions, however, computers have found wide application.[20] Teleprocessing can and does have an obvious part to play in such process control applications of computers, either for firms which are geographically decentralized, making use of a time-sharing computer, or making use of externally generated information as an input to the process control operations.

Within the commercial sector, "point of sale data gathering systems" and "on-line customer credit checking systems" are the most common applications, outside of administrative uses.[21] Teleshopping applications are available on a limited experimental basis, in one case through the use of touch-tone telephones, in another via a videotex system.[22] Videotex can be expected to greatly increase teleshopping applications over the next few years.

The banking/financial sector has been "a leading area" of computer application in Canada for some time and this use increasingly involves teleprocessing applications. Inter-branch operations are now automated as are inter-bank transactions.[23] Customer services are becoming more

automated with such services as "multi-branch banking", cash dispensing machines, and automatic funds transfers. Full electronic funds transfer systems have still not arrived but the trend is, however slowly, in that direction. Banking services provided by videotex, if this becomes a market reality, could be one of the most significant steps in this direction since the technical possibility of tele-banking was first made real ten to fifteen years ago.(24)

In the transportation sector, a highly visible teleprocessing application is the use of "on-line, real-time" reservation systems in the airline industry. These reservation systems are accessible by not only airline company reservation clerks but also by independent travel agents. They provide direct access from remote terminal locations to the carriers' computers, links between domestic carriers and, internationally, access to direct reservations with airlines in other countries. Monitoring and dispatch of vehicle fleets in all commercial transportation services is another area where teleprocessing has been advantageously applied. This has been of particular importance in the rail freight sector.

In the health care sector, hospitals have been computerizing various functions, particularly routine administrative functions, since the 1960's. Globerman estimates that, by 1978, approximately 30% of Canadian hospitals used data processing for either administrative or clinical applications.(25) In many cases, these applications involve the use of an external (to the hospital) computer.(26) Medical information

systems have also developed in North America and many Canadian hospitals and medical professionals make use of these services. Finally more sophisticated telemedicine applications, i.e., remote clinical applications of computers, have been tried in some areas of Canada.

The education sector is beginning to emerge as a potentially major computer user, in part due to the emergence of the micro-computer. Universities have made use of computers for some time (since the 1960's) and computer applications in educational administration have been observable in a number of centres for over a decade. What has now emerged, with the micro-computer, is the real possibility of bringing a relatively powerful computing unit directly into the classroom. Many provinces have already announced and/or are already implementing plans for equipping schools with units and for making use of "computer-assisted instruction" (CAI) techniques. While many of these micro-computer applications will be conducted on-site in schools, there will be networking to facilitate contact/exchanges between instructional staff, "borrowing" of instructional packages, software, and so on.

Another significant trend in education which may merge with computerized applications has been the increasing interest in, and experimentation with, "distance-education". There are two reasons to suggest that distance education may increasingly adopt aspects of CAI. First, as micro-computers

become more widespread in the home, there will be no technical reason why CAI programs created for the classroom cannot also be delivered direct to the home. It can be expected that new programmes, especially in the adult continuing education field, will be developed to serve the home audience of micro-computer owners/users. Second, videotex, when available as a two-way interactive service, offers considerable potential for distance-education applications. At least two current videotex field trials in Canada include a distance-education application,[27] and several on-line CAI systems/courses exist at present.[28]

Library applications of computerization are the other significant area of computer applications in the education sector, if the latter is defined to include libraries. On-line search systems are a particularly notable teleprocessing application in this area. Library networks which use a shared computer for circulation, cataloguing, acquisitions, etc.[29] exist in a number of areas of the country and have been actively promoted by the federal government and provincial governments.[30] Videotex offers considerable potential for library systems to act as information providers (IP's). Search services, information on holdings, reference services, certain circulation services, etc., could, with two-way videotex, operate direct to the home or office. In several current videotex trials in Canada, libraries are participating as IP's and/or serving as locations for the placement of public-access terminals.

Data banks are "extensively used" in various aspects of government administration in Canada,[31] both at the federal and provincial level. There are, in addition, over 100 public data bases in Canada[32]; several of these can be directly accessed by the public while a larger number, generally those provided through service bureaus, can be indirectly accessed through the staff of the service bureau. Videotex promises to both multiply the number of data banks in existence over the next several years and to greatly increase the level of direct public access to these data banks. In the process what may also develop is the more widespread introduction of teleprocessing applications in several sectors of the economy, including some which might not be expected to otherwise evidence a strong computerization trend. An example of such a sector is agriculture.

The "Grassroots" videotex service introduced in Manitoba in 1980 is aimed at the farm/agribusiness sector. It provides farmers with on-line access to a central data bank containing information on weather, commodity markets, farm techniques, etc. It is still too early to predict how successful this service will prove to be.

Much interest is being shown, also, in the application of micro-computers in agriculture. Much of this is still in the experimental stage but the potential benefits appear quite significant. As and when the use of micro-computers on farms becomes widespread, one can readily envisage that networks to allow contact between farmers, to provide access to external data banks, etc., are very likely to develop.

A new networking concept being developed at present by TCTS could be an important innovation for increasing general public and business access to data banks and other computing services. Known as iNet, this system is an "intelligent network" which will be pre-programmed to access computers to which the user is entitled to have access. It will be, in effect, a giant gateway facility providing the user with a single point of access for all of his/her computer needs, however diverse these may be.(33)

Other teleprocessing applications worthy of mention which are currently available in Canada either on a regular commercial basis or an experimental basis are electronic mail and personal computing services.

Electronic mail is still in a relatively experimental stage; certainly it is not yet in widespread use. Nonetheless, Bell Canada now offers its "Envoy" service, a store and forward message system, CN/CP Telecommunications is experimenting with a communicating word processor network called "Infotex",(34) the B.C. Tel. videotex trial includes an electronic mail service, the Canadian post office, in conjunction with CN/CP Telecommunications and Teleglobe Canada, offers "Intelpost", a post-office to post-office electronic mail system, and some service bureaus, such as I.P. Sharp, provide an electronic mailbox service for their clients.

Personal computing use is becoming increasingly widespread with the introduction of micro-computers and video-game machines. In terms of teleprocessing activities, cable companies in Canada and some of the common carrier telephone companies are experimenting in field trials with various home monitoring/security

services such as fire alarms, burglar alarms, energy monitors, etc.[35]

As micro-computers have become more common, user networks for "conversing", exchanging software packages, etc., have started to grow and can be expected to become more widespread as the hardware continues to be purchased, i.e., as the number of users grows, and/or users look to expand their applications of the hardware.[36]

There is some experience with personal terminal equipment tied to a main-frame computer. Where access to a main-frame computer is readily available, this has been a particularly common means of introducing a word processing capability in offices.[37] A "dumb" terminal of this type has, up to now at least, been cheaper than a stand-alone word processing unit and, hence, more economical to adopt where the main-frame computer is already available and hence represents a fixed cost. Present price trends for micro-computers suggest that this advantage may not continue for much longer.

Videotex represents, potentially, the most significant advent of personal computing services available in the home. Reference has previously been made to information-retrieval applications of videotex, teleshopping applications, tele-banking, and electronic mail. Videotex, if it becomes truly widespread, could see all of these applications available in a significant number of Canadian offices and households.

This, perhaps somewhat lengthy, discussion of teleprocessing

applications in Canada in various sectors illustrates the very widespread incidence of present and potential use. In most instances of private sector use, the firms adopting the technology have done so because it was economical. But there is relatively little known about the magnitude of economic benefits involved. In public sector use, in such areas as libraries, hospitals, and government administrative use, it is not as clear that all of the applications have been dictated by efficiency criteria or that the way in which applications have been structured is necessarily the most cost-effective. Globerman's study of computer applications in hospitals, university libraries, grocery retailing and wholesaling, and department and variety stores finds distinct differences in this regard between the first two (which might be considered public-sector, non-profit oriented organizations/institutions) and the last two, (which are private enterprise, profit-motivated organizations).[38]

Globerman's study is worthy of more detailed comment since it is one of the few detailed studies of the determinants and (efficiency) implications of computerization in particular industries or sectors in Canada.

Globerman's study was specifically concerned with the questions of how rapidly firms in Canada in the sectors studied have automated, what factors have contributed to the rate or pace of automation, and what policies (by government) might promote a faster rate of adoption. Specific details of his findings for each of the four sectors examined will

not be reviewed here. In general, the major conclusions reached are:

1. in order to definitively assess the influence of organizational efficiency on the rate of adoption of computing applications it is necessary to have ex ante estimates of the profitability of adoption. In the absence of such estimates, it cannot be definitely stated that adoption rates were slowed by inefficiency
2. structural factors and management attitudes to computer technology may have influenced the rate of adoption
3. competition appears to have been an important positive influence on adoption
4. no consistent relationship between firm size and adoption behaviour was found, contrary to a prior expectation that scale economies and technological indivisibilities would lead to a positive correlation. This could mean that the anticipated scale economies have been overestimated by many observers or that greater inefficiences in larger organizations offset the "higher ex ante profitability of automation".

5. "scaled-down" technology, e.g., mini-computers, represents a promising approach to more rapid adoption of computer applications
6. governments in Canada have, perhaps, been guilty of imposing "an economies-of-scale bias on the process of new technology adoption, at least in regard to public-sector organizations". In both the hospital and library cases, there is reason to believe that government promotion of networks utilizing large central main frames may have slowed down the adoption rate.
7. the promotion/introduction of efficiency-incentive requirements in public sector organizations would likely increase the rate of adoption. This may be difficult to do while still maintaining universality of service considerations; it is not however impossible.
8. to derive definite estimates of ex ante profitability would require in-depth surveys of adopting organizations. Use of published data is not a wholly adequate substitute, although it does permit a broader coverage.[39]

Issues relating to extra-territorial teleprocessing have been the subject of wide concern in Canada.(40) Canada is a very open economy and has particularly strong economic relationships with the United States. Multinationals, typically U.S. parent companies, are prevalent in Canada. The geographic proximity and the economic links of the two countries make it economically and technically feasible for U.S. companies to offer teleprocessing services in Canada or to Canadians. The integration of the Canadian and U.S. telecommunications systems further facilitates trans-border information transactions while the size advantage of U.S. firms and the U.S. market and/or parent/subsidiary relationships bias the exchange in favour of U.S. producers. Several major investigations of the questions surrounding extra-territorial teleprocessing have been carried out but, as yet, the government has not formulated a national informatics plan to deal with these issues.(41)

Implications of Canadian Experience for Developing Countries

This description and analysis of teleprocessing applications in Canada generates a number of conclusions regarding the potential benefits and implications of teleprocessing in developing countries. However, what has happened in Canada, to date, cannot simply be applied directly to developing countries. The structural/institutional characteristics of Canada and the Canadian economy will differ markedly from the characteristics of developing countries. The starting level of economic development is different. The starting level of telecommunications development and computer use is different. The level of market development is different.

Social/cultural/political values and goals may differ. The priority of goals may differ.

Results on areas of teleprocessing application, rates of adoption, magnitude of benefits and costs, impact of extra-territorial teleprocessing, methods of providing service, etc., which are found for Canada or for other developed countries cannot be applied in any quantitative sense to developing countries. In qualitative terms, however, with due regard for the difference in situation of the countries with whom the comparison is made, some meaningful lessons can be drawn.

The openness of the Canadian economy, the role of primary industry and the high incidence of foreign ownership in Canada makes Canadian experience with extra-territorial teleprocessing and the policy considerations by government of how to deal with the issues involved particularly relevant to many developing countries. The latter tend to exhibit many of the same general characteristics regarding primary product orientation, importance of trade, and concern with multinational corporations, although there are obvious differences in kind and in degree. Canadian experience, therefore, can highlight the nature of the problems which extra-territorial teleprocessing may present. If the Canadian government can develop a comprehensive informatics plan in the near future, this also may present one possible model for dealing with extra-territorial applications of teleprocessing, which developing countries could then consider relative to their own circumstances.

Canadian experience demonstrates the importance of management attitudes to the technology as an influence on adoption decisions, the importance of efficiency incentives for public sector organizations regarding the rate of adoption, and the constraint posed by lack of adequately trained, skilled computer specialists. Globerman notes that, in the hospital sector, for example, "management's receptivity to change" was very probably an influence on the decision to automate. He further notes that "industry observers have expressed concern that hospital administrators in both Canada and the United States are risk-averse and have trouble defining their computer needs. Hospital administrators may have weak incentives to cut expenses if they fear that any resulting savings will lead to subsequent budget cuts". Finally, Globerman notes that "the isolation of health professionals from any substantive knowledge of computing was suggested in a number of interviews as being a major barrier to computerizing the health system" and "hospitals under a minimum size.... are unlikely to have competent systems people on staff and may have difficulty articulating their system requirements to outside consultants."(42)

These conclusions, to the extent that they are generalizable to overall Canadian experience, are of significance for developing countries. Attitude factors may be more important in developing countries because of the underdevelopment of telecommunications in general and the special skills/knowledge required by teleprocessing in

particular. It is very important that developing countries seeking to promote teleprocessing applications by domestic organizations recognize that hardware availability, by itself, is not a sufficient condition for achieving the desired results. The hardware capability must not only be present, it must be used and used efficiently.

Public-sector enterprise is quite common in developing countries. Some form of efficiency-incentive system for management to introduce cost-effective technology and/or seek the most efficient means of realizing their organizational objectives may therefore be particularly important regarding the adoption or rate of adoption of teleprocessing applications. In sectors such as health and education most developing countries place a high priority on extending the range of coverage, in terms both of population served and geographic areas served. The nature of the problem of extending coverage through the use of telecommunications, including teleprocessing, is different than the problem of modifying existing practices and methods within existing facilities. This difference could make the problem more or less severe to deal with. Newly created institutions may be less likely to be held back by the inertia of existing practice. On the other hand, the pool of skilled professionals/managers available to draw upon will be the staff of existing institutions. The major advantages of tele-medicine and distance education systems for developing

countries rely, in fact, on the explicit integration of diverse facilities and a sharing or pooling of scarce personnel. These advantages could be lost if the right incentive systems to induce the optimal feasible use of the technology are not adopted.

The scarcity of trained personnel for operating/maintaining computer/communications networks will be of obvious importance for developing countries, where skilled labour shortages are in general a far more acute problem than in developed countries such as Canada. Training facilities will be required in the long run to adequately deal with the skilled manpower problem which even a moderate introduction of domestic teleprocessing applications will create. It may prove to be a good policy, also, to require multinationals engaged in teleprocessing to train local personnel in the various job functions involved with the teleprocessing application. In the short run, expatriate staffing may provide a partial solution but there is a relative scarcity of trained computer personnel in many developed countries, including Canada, which may make this difficult. It should in any event not be seen as a permanent solution. It may also be desirable, subject to cost considerations, to push for modifications in the hardware technology which makes the hardware both more "user-friendly" and more self-sufficient in terms of operation and maintenance.

Canadian experience suggests that strong attention must be given to the scale-bias of the computer and network

options available. Small computer units can now be as effectively networked as large units and have the "advantage" of providing a local autonomous computing capacity which "dumb" terminals do not. Developing countries may find that needs and financial constraints dictate "scaled down" technology for many domestic applications and that use of such an option, given Canadian experience, may lead to a much more rapid diffusion of the technology. Developing countries are in an advantageous position to profit, in this instance, from the experience of developed countries such as Canada. The early adoption of computers and teleprocessing applications in Canada took place at a time, 10 to 15 years ago, when mini-computers as they exist today were unknown and the thinking of most experts favoured centralized processing versus decentralized distributed processing. There is still no unanimous agreement on this issue amongst experts in the computer field but, as Globerman points out, the economies of scale which were generally assumed to be present may not be as large as expected.(43) More importantly, medium-and small-sized organizations who were given only the option of participating in centralized processing networks were often not large enough to utilize this option effectively. As a result the rate of adoption was slower than it should or could have been.

Developing countries today have the option of using high-powered, scaled-down technology and providing networking between such units. They do not need to repeat the possible

mistakes of Canada in this regard. The most appropriate technology should be chosen; this is not always the biggest. It has been charged by some observers that PTT's in developing countries have, at times, been guilty of favouring "prestige" equipment even when it was not the most appropriate for the needs at hand.(44) If this charge is true, it is important that the experience not be replicated with regard to computer and teleprocessing applications. Perhaps, more significantly, equipment manufacturers often promote technology based on their own profit concerns rather than countries' needs. Careful consideration must be given to the manufacturer's claims and, at a minimum, competitive bidding by alternative manufacturers should be encouraged.

To quote the MacBride Commission:

> Simple, appropriate technology, making use of more readily adaptable facilities and methods and more capable of providing the type of immediate solutions aimed at, may often be a more valuable asset for developing countries than advanced technologies, whose cost may put them completely beyond reach and which may well prove to be unsuited to the purposes which they are expected to serve. In view of the rapid obsolescence of certain technologies, it is frequently in the best interests of developing countries to adopt low-cost, small scale technologies rather than excessively sophisticated systems....
> Governments and other decision-making bodies are often unaware of the range of possible choices. Over-impressed by salesmanship from the dominant manufacturers, they fail to examine the relative merits of different classes of equipment....Government authorities, who sometimes have their sights set on the industrialized world's most modern technologies, should accept the idea that appropriate technologies are not in all cases inferior technologies....(45)

The inadequacy of published data for rigorous quantification of teleprocessing applications and benefits in Canada and Globerman's conclusion on the use of detailed surveys of users to solve this problem is highly relevant to the assessment of teleprocessing in developing countries. Published data in most developing countries is typically not as extensive or as recent as the available Canadian data. And it may not be as reliable. In these circumstances, Globerman's conclusions on the appropriate methodology for assessment in the Canadian case becomes even stronger for developing countries. Methodological problems and suggested solutions are discussed in more detail in Part III of this report.

Canadian experience demonstrates the importance of developing countries formulating a comprehensive, national informatics plan. Canada has not yet completed this task. Much effort has, however, already been expended in working towards this goal. It might, perhaps, be suggested that the process is taking too long. Nevertheless, the many studies which have already been done could prove very useful for developing countries in developing, or working towards, plans of their own.

Implications for Developing Country Case Study

The above discussion of Canada's teleprocessing experience has several implications for the case studies of teleprocessing activity to be carried out in Phase II of the work of GAS/5, Study Group No. 6.

First, and very importantly, the general methodology followed in the Canadian study will not, in most cases, be applicable to developing country studies. The Canadian study is largely based on secondary sources. For most developing countries, such sources do not exist or may not be in the public domain. Many of the Canadian secondary sources have resulted from the Canadian government's efforts to formulate a national informatics plan. This is a process which many developing countries have not yet initiated or are only just beginning. Hence, studies of a comparable nature to those found for Canada have not been carried out, as yet. The availability, and the quality, of up-to-date statistical information is often not very good in many developing countries. This further compounds the difficulty of relying on published sources of information. Finally, the teleprocessing experience of most developing countries is still so relatively limited that one would not expect to find much regarding existing, documented uses. Indeed, the potential applications of teleprocessing and the resulting implications appear far more important than existing applications, at least in the aggregate. Insofar as the methodology used for the developing country case studies relied on secondary sources, as the Canadian case study does, a bias towards existing versus potential applications could result which would be inconsistent with the relative importance of the two.

While the general methodology of the Canadian study may not be applicable to the developing country case studies,

certain specific aspects of the methodology are: the identification of questions/issues to be examined; the identification of the type of information required to analyze various questions/issues; and the use of hypotheses formulated from Canadian experience regarding the determinants of adoption, the user benefits, the social benefits, etc., for testing purposes in developing countries.

Canadian experience demonstrates the benefits that can be realized from teleprocessing applications across a wide cross-section of sectors and users. While these benefits cannot be directly applied in quantitative terms to developing countries, they are illustrative of the validity of the hypothesis that teleprocessing can positively influence economic and social development. The benefits which can be demonstrated or shown for Canada provide a strong and prior justification for developing countries to closely examine their own potential for utilizing the technology on terms appropriate to their own circumstances.

Footnotes:

1. S. Serafini and M. Andrieu, The Information Revolution and Its Implications for Canada (Ottawa: Supply and Services, 1981).

2. Consultative Committee on the Implications of Telecommunications for Canadian Sovereignty, Telecommunications and Canada, (Ottawa: Supply and Services, 1979), p. 23.

3. R. Collins, A Voice From Afar: The History of Telecommunications in Canada, (Toronto: McGraw-Hill Ryerson, 1977), p. 208.

4. Consultative Committee...., op. cit., p. 23.

5. Packet switching is "a data transmission process that transmits addressed packets so that a channel is occupied only for the duration of transmission of a packet" (D. Godfrey and D. Parkhill (eds.), Gutenberg Two, (Victoria: Porcepic Press, 1980), p. 212.

6. Collins, op. cit., p. 277.

7. Max Beere, "The Power of Telecommunications: We've Unleashed It. Can We Control It?" Computerworld Extra, XV, 11a, March 18, 1981, p. 11.

8. Computer/Communications Secretariat, The Growth of Computer/Communications in Canada (Revised Draft), March 1978, p. 92.

9. Ibid., pp. 92-93.

10. Ibid., p. 1.

11. Ibid., p. 2.

12. Ibid., p. 1.

13. Ibid., pp. 2-3.

14. Ibid., p. 3.

15. Ibid., p. 3.

16. Ibid., p. 5.

17. Data for Development, National Policies and the Development of Automatic Data Processing, March 1979, p. 50.

18. S. Globerman, The Adoption of Computer Technology in Selected Canadian Service Industries (Ottawa: Economic Council of Canada, 1981), p. 2.

19. See, for example, Data for Development, op. cit., p. 64 and S. Serafini and M. Andrieu,, op. cit., p. 23.

20. Data for Development, op. cit., p. 64.

21. Ibid., p. 65. See also, S. MacFarlane, "Computers in Retailing", Canadian Data Systems, May 1980, pp. 29-37.

22. Ibid., p. 65, refers to the touch-tone telephone application. The videotex system referred to is the "Grassroots" service in Manitoba.

23. Ibid., p. 65.

24. For a discussion of the current status of telebanking see Ibid., pp. 66-67 and Serafini and Andreu, op. cit., pp. 82-83. For a more complete discussion of full EFTS, see J. Lambie, Electronic Funds Transfer Systems: Emerging Issues and Recommendations, Research Monograph Number 3, Bureau of Competition Policy, Consumer and Corporate Affairs Canada, 1979.

25. Globerman, op. cit., p. 21.

26. In Ontario, for example, the government promoted regional computing centres for hospitals in the early 1970's. B.C. used a central service bureau when computer services were started in the 1960's and hospitals in Alberta, Saskatchewan, and Manitoba are on group systems run by provincial health ministries. Globerman, op. cit., p. 48, fn. 19).

27. These are the AGT trial and the OECA trial.

28. For a general discussion of CAI and distance education see D. Godfrey, "No More Teacher's Dirty Looks", in D. Godfrey and D. Parkhill, op. cit.

29. For a list of the areas of application in university libraries, see Globerman, op. cit., p. 29.

30. Ibid., pp. 17-18.

31. Data for Development, op. cit., p. 69.

32. Ibid., p. 70. This is a 1978 figure.

33. The Computer Communications Group, Trans Canada Telephone System, Press Release, May 20, 1981.

34. This is described in Serafini and Andrieu, op. cit., p. 83.

35. The New Brunswick videotex field trial, for example, includes emergency service monitoring. See M. Kurchak, Telidon: The Information Providers (Ottawa: Department of Communications, 1981), pp. 27.28.

36. For a discussion of network concepts and the new Canadian experience see D. Godfrey and E. Chang (eds.), The Telidon Book, (Victoria: Press Porcepic, 1981) Chapter 9.

37. Data for Development, op. cit., p. 73.

38. Globerman, op. cit.

39. Ibid., pp. 41-43.

40. See, for example, Serafini and Andrieu, op. cit.; Computer/Communications Secretariat, op. cit.; Consultative Committee....., op cit.; Data for Development, op cit.; and W. Cundiff and M. Reid, Issues in Canadian/U.S. Transborder Computer Data Flows", (Montreal: IRPP, 1979).

41. Serafini and Andrieu, op. cit., pp. 87-89.

42. Globerman, op. cit., Ch. 3.

43. Globerman, op. cit., p. 24.

44. See, for example, L. Gimpelson, "Planning Communication Systems in Developing Countries", IEEE Transactions on Communications, COM-24, 7, 1976.

45. S. MacBride, et. al., Many Voices, One World, Report by the International Commission for the Study of Communication Problems, (Paris: UNESCO, 1981), pp. 216-217.

Part III

Assessing Teleprocessing Applications in Developing Countries: A Proposed Methodology and Recommended Countries for Study

As discussed in Part I, there is, at the present time, relatively little concrete experience with teleprocessing in developing countries. There is limited use by domestic governments, significant use by multinationals, and some use by international organizations. There are relatively very few internal or domestic applications compared to the number of external or international applications. There are few cases of public access networks with data transmission capability. There are few domestic data banks in developing countries. And there are very few domestic service bureau operators.

On the other hand, as the discussion of Part I also pointed out, there are teleprocessing applications in developing countries, although many of these have not been very well documented or studied to this point. The study of these applications is, however, important. The decision by PTT's and governments to introduce the required technology and investments and to foster appropriate applications will to a very large extent depend on the ability to demonstrate to national governments and PTT's the economic and social gains made possible by the technology and its use.

There are considerable problems, methodologically, in measuring the benefits of telecommunications. These problems arise from the fact that the social benefits of telecommunications can be expected to greatly exceed the private benefits as reflected in the net return to the service provider. This results from the externality or spill-over characteristic of telecommunications[1] and the fact that telecommunications per se is simply a means of information conveyance whereas the real value of the transaction lies in the content of the information conveyed. This, in turn, means that attention cannot focus exclusively on any single plant investment nor can plant investment be treated as a proxy for a single homogeneous consumption item or production input.[2]

There have been various attempts made at quantifying the benefits of telecommunications but, for the most part, these studies have failed because of the problems just noted.[3] What is required is a case-study type, micro-level approach which examines individual users and uses, for specific investments placed in the proper network context.[4]

For the more particular case of teleprocessing the same problems are present and the same approach is therefore required. Thus, in order to evaluate the benefits (and, by the same token, the costs) of teleprocessing for a given country the following steps are ideally required:

1. identification of teleprocessing applications

2. identification of teleprocessing networks
3. identification of teleprocessing users
4. detailed investigation, by user, of the content and objectives of teleprocessing applications
5. calculation of the imputed value to the user of the content of teleprocessing applications
6. identification and quantification of spin-off benefits and costs of teleprocessing applications, individually or by type of application if the latter is possible, and including non-economic as well as economic effects.
7. calculation of the net benefit ratio of individual teleprocessing applications which can be summed or extrapolated (depending on the completeness of 4., 5., and 6.) to arrive at an aggregate measure of the benefit/cost ratio of teleprocessing.

This procedure, while it may be an ideal one, is not, however, a very practical one, especially for developing countries. There are several reasons for this:

1. the scope of such a study if done for an entire country would be too large, too costly, and too time-consuming.

2. the quality of data on telecommunications infrastructure, including teleprocessing applications, is typically very poor for developing countries and very frequently out of date. Moreover, even in developed countries, the form of published data may be inappropriate to the task at hand.[5]
3. very few developing countries have a public-access data network, making it more difficult, potentially, to identify applications and users.
4. governments and multi-national corporations are the principal users of teleprocessing, at present, in most developing countries. In both cases, confidentiality concerns are likely to be particularly significant and may make it impossible to analyze information content in order to calculate an imputed value for the information transaction.
5. many of the non-economic costs and benefits will involve social/cultural/political implications which involve ethical/social values of the society. Such costs and benefits cannot, typically, be quantified.
6. because the range of teleprocessing applications in developing countries and the level of participation by business users

and individuals are still very limited, many of the benefits and costs, both social and private, are potential rather than actual benefits and costs. In other words, a study which looked only at actual applications at the present time would seriously underestimate the potential net benefits.

7. all price information relating to benefits and costs must typically be expressed in terms of shadow prices in developing countries because of the discrepancy which typically exists between nominal market prices and the real social price of investment funds, foreign exchange, domestic material inputs and labour inputs. Such shadow prices, however, may be difficult to calculate.

All of these factors taken together strongly suggest that it would be inappropriate, at this time, for the proposed case studies of developing countries to attempt to quantify the costs and benefits of teleprocessing applications in the respective countries being examined. There are, however, a number of important tasks which the case studies could realistically expect to accomplish. These are:

1. a documentation of the present telecommunications

system and planned additions/expansion in the near to medium-term, including an assessment of data transmission capabilities

2. the identification/documentation of the current status of computer use
3. the identification/documentation of present, actual applications of teleprocessing and potential applications of teleprocessing
4. the identification of additional telecommunications infrastructure required to realize the potential applications documented in 3., if these are not already provided for in the expansion plans outlined in 1.
5. the detailed documentation, insofar as possible, of a selected, small number of specific applications regarding
   a) the objectives which the teleprocessing application(s) is designed to achieve and the type of information transmitted/received
   b) the identity (by name of by type) of the users network correspondents
   c) the nationality and location of network correspondents and national origin of information content

d) the identity of domestic industries/agencies/individuals with whom the user has business relationships directly or indirectly influenced by the teleprocessing application in question

e) the user's perception of the private benefits derived from the teleprocessing application in question

f) the user's perception of the impact of government regulations (if any) which constrain the desired or preferred use of teleprocessing

g) the alternative information-transfer modes which would be utilized by the user if the teleprocessing option was not available

h) the network/computer facilities involved in the application

i) the user's reasons for choosing the particular facilities involved

j) alternative facilities which could be used and the reasons for rejection of these alternatives

k) possible additional applications or extensions of existing applications of teleprocessing which the user may be considering introducing

6. the documentation, insofar as possible, of government and/or PTT policies/plans regarding
   a) the introduction or extension of public access data networks
   b) policy regarding leased lines, and domestic data banks linked to, or which might be linked to, data networks
   c) extra-territorial teleprocessing
   d) tariff structures governing teleprocessing
   e) domestic manufacturing of hardware components for teleprocessing applications
   f) status of domestic software industry
   g) domestic training facilities/programmes for personnel involved with teleprocessing (key punch operators, programmers, etc.)
   h) the economic and social impact of teleprocessing
7. the identification, insofar as possible, of the domestic linkages of teleprocessing users and an assessment of the importance of these linkages to the domestic economy.
8. conclusions regarding the net benefits to users of the specific teleprocessing applications examined in 5.

9. conclusions on the social benefits and costs of teleprocessing for the country in question, based in large part on 6.
10. to the extent possible, generalization of the results in 8. and 9. to the entire range of actual and potential teleprocessing applications with particular emphasis on the types of benefits (private and social) realizable from teleprocessing applications, the probable magnitude of benefits (private and social) realizable from teleprocessing applications, the system costs of teleprocessing networks, the social costs of teleprocessing (both economic and non-economic), and the impact of extraterritorial teleprocessing.

The information/analytical components that this proposed methodology will provide are:

1. a profile of users, hardware, and networking options currently available
2. a profile of actual applications at present
3. a profile of potential applications
4. a qualitative assessment of the private net benefits of teleprocessing and of the social benefits and costs of teleprocessing for, at least, the specific users and applications studied in detail.

5. a summary of government policies/attitudes towards teleprocessing in general and extra-territorial teleprocessing in particular.
6. general conclusions on types of benefits and costs (both economic and non-economic) and, insofar as possible, indications regarding magnitudes of benefits and costs for teleprocessing in general and extraterritorial teleprocessing in particular.

The methodology as proposed will not produce rigorous, quantified results. Pragmatically, given the methodological problems of quantification, confidentiality concerns and the scope of the proposed study, it is not practical to create a methodology which attempts to do so. Qualitative results, however, can yield meaningful analytical results so long as they are rooted in concrete experience, which is the case for the methodology proposed.

The methodology does not depend on the necessary cooperation of any particular user so long as some users are prepared to cooperate. The methodology does, to a greater degree, depend on the cooperation of government and PTT officials for access to information on government regulations/policy, network development plans, tariff (price) structures, training facilities/programmes, etc. Some of this information may be available in published form but much of it may not be, depending on the country.

Even where the information itself is published, the interpretation of the information may only be obtainable through direct contact with relevant officials.

The methodology, as proposed, to be properly carried out, could require field visits to the countries involved by members of the study team. As previously noted, secondary sources often do not exist or are likely to be insufficient for the tasks involved.(6) Moreover, actual or potential domestic applications of teleprocessing are one of, if not the most, important components of potential net benefits for developing countries. It may not be possible to properly identify and assess these except through field visits to the countries in question.

If, despite the desirability of undertaking country visits, such visits prove impossible for all or some of the countries to be studied, the study-team members should, instead, make use of detailed survey questionnaires to be sent to users and government/PTT officials. Such questionnaires will provide an alternative form of direct contact. The respective questionnaires should emphasize the major issues outlined above regarding the detailed documentation of a few specific applications and government/PTT policies and plans. Study team members may find it useful to utilize their country's embassy in the countries to be studied to assist in the identification of appropriate users and government/PTT agencies and individuals with whom contact is to be established.

It should be noted that if field visits do prove possible, study team members may still find it useful to make use of

their own-country embassies in the countries being studied to identify appropriate contacts and to secure their cooperation prior to the field visit actually being made.

There are also a number of other ways in which part of the information called for by the methodology can be collected. First, for users which are subsidiaries of multinational corporations, interviews with head-office personnel may yield the required information. In some cases it may even be more forthcoming from head-office staff; branch personnel often are unsure of their discretionary limits on the release of information without seeking head-office approval. Moreover, branch personnel may not be aware of why particular adoptions or methods of adoption were made; these decisions are typically made by head-office personnel and the reasons for the decision versus the decision itself may not be communicated to branch offices. Given that the study-team members are from Canada, France, and Spain, head-offices are likely to be closer and perhaps easier to deal with than branch offices in a developing country. Second, service bureaus in North America and Europe can be interviewed regarding the extent of their business operations in developing countries, opportunities which they perceive for expanding their operations into, or in, developing countries, the network facilities which such expansion would require and the impact on their operations of government imposed limitations on extra-territorial teleprocessing. Finally, international organizations, both public and private, involved in teleprocessing in developing countries can be

interviewed. The World Meteorological Organization (headquartered in Geneva), for example, can be interviewed regarding the WMO's "Data Exchange Network".(7) For an assessment of teleprocessing applications in banking, information can be sought from SWIFT or developed country banks who are members of SWIFT with branches, or doing business in, developing countries.(8) The airline reservations system, SITA, provides another example.(9)

It is important to stress that the exclusive emphasis of the proposed methodology is not direct user benefits and hence, exclusive reliance on user contacts will greatly reduce the value of the case studies. It is important to see the user in a country context, i.e., to evaluate the teleprocessing application not only as a private economic activity but also in terms of the social, cultural, and political environment of the country involved.

Depending on the willingness of specific users to release the necessary information, it could prove possible for these cases to quantify the direct returns to users of teleprocessing applications. Such cooperation may be difficult to achieve. To the extent that it is obtained, the actual measurement exercise must be careful to distinguish between the benefits of a teleprocessing application and its costs, what might be called the effectiveness of the application, and how well the particular application is carried out, what might be called the efficiency of the application.(10) Both of these are important but they represent different questions and must

be carefully distinguished. Balls argues that

> In 1965, the computer was relative new. The focus was on automatic data processing. The challenge was to fit problems to the available tools and to resolve the immediate problems of efficiency so that reasonable results could be produced in reasonable time. Now, in 1974, computers are more powerful. No longer is there the absorbing concern to adapt to the constraints of the tools. The concern now extends to the effectiveness of information systems. The narrow focus on ways and means has widened beyond the tools and their efficient use to include the effectiveness with which goals are met.(11)

This statement may be relatively true for developed countries although it could still be debated. In a developing country context, however, as the discussion of Part II on equipment or hardware choice illustrates, the efficiency of teleprocessing applications must still be considered of primary importance. Thus both effectiveness and efficiency should be considered in any quantitative assessment of teleprocessing applications. If quantification is not attempted, i.e., if benefits and costs are assessed simply in qualitative terms, the effectiveness/efficiency distinction can and should still be incorporated into the analysis. This is already implied in the called for assessment of alternative equipment and network, i.e., facilities, options.

As noted previously, the methodology which has been outlined here should be usable with any developing country where at least some teleprocessing activities already exist. At the same time, however, the choice of countries for which case studies might be carried out cannot be decided in a wholly arbitrary way. Given that the presently defined

efforts of the GAS/5 Study Team assigned to this task are necessarily limited in scope and in time, only a limited number of case studies can be carried out. If these are to be successfully undertaken and if results of significant import are to be generated, then the following criteria are relevant to the process of selecting the case study subjects:

1. the countries should have a relatively well-developed telecommunications network compared to the average situation of developing countries.
2. the countries should have a relatively developed economy compared to developing countries on average.
3. the countries should have a reasonably wide experience with computer applications
4. the countries should have experience with a number of teleprocessing applications
5. at least some, if not all countries to be studied should be among the group of developing countries which have developed national informatics plans.(12)
6. at least some, if not all countries to be studied should have some domestic manufacturing capability, at present, either in telecommunications equipment and supplies or computers and computer peripherals.

7. the countries should be ones for which a reasonable quantity of relevant published statistics, which are reliable and relatively up to date, are available.
8. the countries should be ones which will be prepared to cooperate with the study team's efforts by making available information as requested.
9. at least some of the countries should be ones in which some multinational corporations and other international organizations make use of teleprocessing applications.
10. the countries should reflect an appropriate distribution by geographical region.

These criteria may seem self-evident but it is, nonetheless, useful to list them to use as a check-list for countries under consideration. Many developing countries cannot satisfy all of these criteria, especially the first two. These two, however, are particularly important. Essentially they mean that the countries to be included in the study should be middle-income countries, having a relatively well-developed telecommunications infrastructure.

These two characteristics generally go together as was observed in Part I of this report. The reason for excluding low-income countries is that the current applications of teleprocessing are likely to be fewer in number, the cost of potential domestic teleprocessing applications will be harder

to justify, the range of potential domestic teleprocessing applications will be limited by the lower stage of development and constraints such as skilled manpower shortages are likely to be more pronounced.

The countries recommended for case studies are:

1. Brazil
2. Mexico
3. Ivory Coast
4. Algeria
5. India
6. Republic of Korea

These countries are, within their respective geographic spheres, relatively well-developed in economic terms. They all have relatively well-developed telecommunications systems. They all have teleprocessing applications in place and experience in the computer field. Brazil is of particular interest given its very comprehensive national informatics plan.(13) Brazil, Mexico, Algeria, India, and Korea are countries which have established an equipment manufacturing sector.(14) Ivory Coast is experimenting with new educational delivery systems as is India.(15) Algeria has a relatively long experience with computerization dating back to the late 1960's.(16)

While these countries share certain general characteristics, as just noted, there is, nonetheless, considerable diversity amongst them in terms of economic development and telecommunications systems. They differ as well in structural and

institutional terms. Thus, as a sample, they provide a cross-section of different levels of development, structural and institutional characteristics, demographic/geographic characteristics, and telecommunications development. From this diversity it should be possible to draw a number of observations on the potential role of such differences on the adoption of and implications of teleprocessing applications.

Footnotes:

1. For a discussion of externalities see B. Lesser and L. Osberg, The Socio-Economic Development Benefits of Telecommunications, a report prepared for the ITU, (Halifax: Dalhousie University, 1981), Appendix 4. See also, R. Artle and C. Averous, "The Telephone System As A Public Good", The Bell Journal of Economics and Management Science, 4, 1, 1973; L. Squire, "Some Aspects of Optimal Pricing for Telecommunications", The Bell Journal of Economics and Management Science 4, 2, 1973; and J. Rohlffs, "A Theory of Interdependent Demand for a Communications Service", The Bell Journal of Economics and Management Science, 6, 1, 1975.

2. See B. Lesser, "Methodological Issues Involved in Assessing the Economic Impact of Telecommunications With Special Reference to Isolated and Underprivileged Areas", Workshop on Special Aspects of Telecommunications Development in Isolated and Underprivileged Areas of Countries (Ottawa: Department of Communications, 1978), pp. 244-251; B. Lesser, "On Assessing the Benefits of Telecommunications: Some Proposed Methodologies", a paper presented at the Expert Meeting on Telecommunications and Development, sponsored by ITU/OECD, Paris, 1978, pp. 2-4; and B. Lesser and L. Osberg, op. cit., Appendix 8.

3. For examples of existing attempts at quantification see P. Shapiro, "Telecommunications and Industrial Development", IEEE Transactions on Communications, COM-24, 3, 1976; D. Marsh, "Telecommunications as a Factor in the Economic Development of a Country", IEEE Transactions on Communications, COM-24, 7, 1976; E. Bebee and E. Gilling, "Telecommunications and Economic Development: A Model for Planning and Policy Making", Telecommunications Journal, 43, 8, 1976; B. Wellenius, "Estimating Telephone Necessities in Developing Nations", IEEE Transactions on Communications, June 1969; and R. Saunders and J. Warford, "Evaluation of Telephone Projects in Less Developed Countries", P. U. Report No. PUN 37, (Washington: World Bank, 1978).

4. See Lesser, op. cit. (footnote 2.)

5. See, for example, Computer/Communications Secretariat, The Growth of Computer/Communications in Canada, (Revised Draft), March 1978, pp. 7-11.

6. See the discussion regarding in-depth surveys in Part II.

7. For a description of this network, see J. Labrousse, "The Data Exchange Network of the World Meteorological Organization", Telecommunications Journal, 43, VIII, 1976.

8. "SWIFT" stands for the Society for Worldwide Interbank Financial Telecommunications. Swift has 800 banks from 32 countries in Europe, North America, Asia, and Latin America as members. For a description of SWIFT see Z. Zeman, "SWIFT geobanking is an example of the multinational banking approach", CIPS Review, May/June 1981.

9. SITA is an international airline reservation system operated through the International Air Transport Association.

10. See A. B. Frielink, "Summary and Conclusions", in A. B. Frielink, (ed.), Economics of Informatics, (New York/Amsterdam: American Elsevier/North-Holland, 1975), p. 1.

11. H. R. Balls, "Introductory Remarks to the First Plenary Session", in Frielink, op. cit., p. 11. The Frielink book, it should be noted, contains several excellent papers on the measurement of effectiveness and efficiency of computer applications.

12. See J. Eger, "The International Information War", Computerworld Extra, XV, 11a, March 18, 1981. Eger reports that over 50 developing countries have adopted a comprehensive national informatics plan, (p. 104).

13. See Eger, op. cit., p. 103; and Intergovernmental Bureau for Informatics, Transborder Data Flow: Its Environment and Consequences, Green Series, Documents on Policies for Informatics, SPIN 231, June 1980, Annex 6.

14. See S. MacBride, et. al., Many Voices, One World, Report by the International Commission for the Study of Communication Problems, (Paris: UNESCO, 1981), p. 214.

15. Ibid., p. 91.

16. See M. Bourafa, "The Algerian Computerization Plan", in Frielink, op. cit.